Configuring Radio Resource Management

Finding Feature Information

Your software release may not support all of the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Configuring Radio Resource Management

The switch should be configured as a mobility controller and not a mobility anchor to configure Radio Resource Management. It may require dynamic channel assignment functionality for the home APs to be supported.

The new mobility architecture that involves mobility controller and mobility agent must be configured on the switch or controllers for RRM to work.

Note   Refer Mobility Configuration Guide for configuring mobility controller and mobility agent.

Restrictions for Radio Resource Management

The number of APs in a RF-group is limited to 500.

If an AP tries to join the RF-group that already holds the maximum number of APs it can support, the device rejects the application and throws an error.

Information About Radio Resource Management

The Radio Resource Management (RRM) software embedded in the switch acts as a built-in RF engineer to consistently provide real-time RF management of your wireless network. RRM enables switches to continually monitor their associated lightweight access points for the following information:

- Traffic load—The total bandwidth used for transmitting and receiving traffic. It enables wireless LAN managers to track and plan network growth ahead of client demand.

- Interference—The amount of traffic coming from other 802.11 sources.

- Noise—The amount of non-802.11 traffic that is interfering with the currently assigned channel.

- Coverage—The Received Signal Strength (RSSI) and signal-to-noise ratio (SNR) for all connected clients.

- Other —The number of nearby access points.

RRM performs these functions:

- Radio resource monitoring

- Transmit power control

- Dynamic channel assignment

- Coverage hole detection and correction

- RF grouping

Radio Resource Monitoring

RRM automatically detects and configures new switches and lightweight access points as they are added to the network. It then automatically adjusts associated and nearby lightweight access points to optimize coverage and capacity.

Lightweight access points can scan all valid channels for the country of operation as well as for channels available in other locations. The access points in local mode go "off-channel" for a period not greater than 60 ms to monitor these channels for noise and interference. Packets collected during this time are analyzed to detect rogue access points, rogue clients, ad-hoc clients, and interfering access points.

Note   In the presence of voice traffic or other critical traffic (in the last 100 ms), the access points can defer off-channel measurements. It also defers based on WLAN scan defer priority configurations.

Each access point spends only 0.2 percent of its time off-channel. This activity is distributed across all access points so that adjacent access points are not scanning at the same time, which could adversely affect wireless LAN performance.

RRM supports new mobility architecture for RF grouping that involves Mobility Controller (MC) and Mobility Agent (MA).

- Mobility Controller (MC)—The Cisco WLC 5700 Series Controllers, Cisco Catalyst 3850 Switch, or Cisco Unified Wireless Networking Solution controller can act as MC. The MC has MC functionality and MA functionality that is running internally into it.

- Mobility Agent (MA)—The Mobility Agent is the component that maintains client mobility state machine for a mobile client.

Information About RF Groups

An RF group is a logical collection of Cisco WLCs that coordinate to perform RRM in a globally optimized manner to perform network calculations on a per-radio basis. An RF group exists for each 802.11 network type. Clustering Cisco WLCs into a single RF group enable the RRM algorithms to scale beyond the capabilities of a single Cisco WLC.

RF group is created based on following parameters:

- User-configured RF network name.

- Neighbor discovery performed at the radio level.

- Country list configured on MC.

RF grouping runs between MCs.

Lightweight access points periodically send out neighbor messages over the air. Access points using the the same RF group name validate messages from each other.

When access points on different Cisco WLCs hear validated neighbor messages at a signal strength of −80 dBm or stronger, the Cisco WLCs dynamically form an RF neighborhood in auto mode. In static mode, the leader is manually selected and the members are added to the RF Group. To know more about RF Group modes, RF Group Leader.

> **Note** RF groups and mobility groups are similar in that they both define clusters of Cisco WLCs, but they are different in terms of their use. An RF group facilitates scalable, system-wide dynamic RF management while a mobility group facilitates scalable, system-wide mobility and Cisco WLC redundancy.

RF Group Leader

Starting in the 7.0.116.0 release, the RF Group Leader can be configured in two ways as follows:

- Auto Mode—In this mode, the members of an RF group elect an RF group leader to maintain a "master" power and channel scheme for the group. The RF grouping algorithm dynamically chooses the RF group leader and ensures that an RF group leader is always present. Group leader assignments can and do change (for instance, if the current RF group leader becomes inoperable or if RF group members experience major changes).

- Static Mode—In this mode, the user selects a Cisco WLC as an RF group leader manually. In this mode, the leader and the members are manually configured and are therefore fixed. If the members are unable to join the RF group, the reason is indicated. The leader tries to establish a connection with a member every 1 minute if the member has not joined in the previous attempt.

The RF group leader analyzes real-time radio data collected by the system, calculates the power and channel assignments, and sends them to each of the Cisco WLCs in the RF group. The RRM algorithms ensure system-wide stability and restrain channel and power scheme changes to the appropriate local RF neighborhoods.

In Cisco WLC software releases prior to 6.0, the dynamic channel assignment (DCA) search algorithm attempts to find a good channel plan for the radios associated to Cisco WLCs in the RF group, but it does not adopt a new channel plan unless it is considerably better than the current plan. The channel metric of the worst radio in both plans determines which plan is adopted. Using the worst-performing radio as the single criterion for adopting a new channel plan can result in pinning or cascading problems.

Pinning occurs when the algorithm could find a better channel plan for some of the radios in an RF group but is prevented from pursuing such a channel plan change because the worst radio in the network does not have any better channel options. The worst radio in the RF group could potentially prevent other radios in the group from seeking better channel plans. The larger the network, the more likely pinning becomes.

Cascading occurs when one radio's channel change results in successive channel changes to optimize the remaining radios in the RF neighborhood. Optimizing these radios could lead to their neighbors and their neighbors' neighbors having a suboptimal channel plan and triggering their channel optimization. This effect could propagate across multiple floors or even multiple buildings, if all the access point radios belong to the same RF group. This change results in considerable client confusion and network instability.

The main cause of both pinning and cascading is the way in which the search for a new channel plan is performed and that any potential channel plan changes are controlled by the RF circumstances of a single radio. In Cisco WLC software release 6.0, the DCA algorithm has been redesigned to prevent both pinning and cascading. The following changes have been implemented:

- Multiple local searches—The DCA search algorithm performs multiple local searches initiated by different radios within the same DCA run rather than performing a single global search driven by a single radio. This change addresses both pinning and cascading while maintaining the desired flexibility and adaptability of DCA and without jeopardizing stability.

- Multiple channel plan change initiators (CPCIs)—Previously, the single worst radio was the sole initiator of a channel plan change. Now each radio within the RF group is evaluated and prioritized as a potential initiator. Intelligent randomization of the resulting list ensures that every radio is eventually evaluated, which eliminates the potential for pinning.

- Limiting the propagation of channel plan changes (Localization)—For each CPCI radio, the DCA algorithm performs a local search for a better channel plan, but only the CPCI radio itself and its one-hop neighboring access points are actually allowed to change their current transmit channels. The impact of an access point triggering a channel plan change is felt only to within two RF hops from that access point, and the actual channel plan changes are confined to within a one-hop RF neighborhood. Because this limitation applies across all CPCI radios, cascading cannot occur.

- Non-RSSI-based cumulative cost metric—A cumulative cost metric measures how well an entire region, neighborhood, or network performs with respect to a given channel plan. The individual cost metrics of all access points in that area are considered in order to provide an overall understanding of the channel plan's quality. These metrics ensure that the improvement or deterioration of each single radio is factored into any channel plan change. The objective is to prevent channel plan changes in which a single radio improves but at the expense of multiple other radios experiencing a considerable performance decline.

The RRM algorithms run at a specified updated interval, which is 600 seconds by default. Between update intervals, the RF group leader sends keepalive messages to each of the RF group members and collects real-time RF data.

Note Several monitoring intervals are also available. See the Configuring RRM section for details.

RF Group Name

A Cisco WLC is configured with an RF group name, which is sent to all access points joined to the Cisco WLC and used by the access points as the shared secret for generating the hashed MIC in the neighbor messages. To create an RF group, you configure all of the Cisco WLCs to be included in the group with the same RF group name.

If there is any possibility that an access point joined to a Cisco WLC may hear RF transmissions from an access point on a different Cisco WLC, you should configure the Cisco WLCs with the same RF group name. If RF transmissions between access points can be heard, then system-wide RRM is recommended to avoid 802.11 interference and contention as much as possible.

Mobility Controller

An MC can either be a group leader or a group member. One of the MCs can act as a RF group leader based on RF grouping and RF group election with other MCs. The order of priority to elect the RF leader is based on the maximum number of APs the controller or switch can support. The highest priority being 1 and the least being 5.

1 WiSM 2 Controllers

2 Cisco WLC 5700 Series Controllers

3 WiSM 1 Controllers

4 Catalyst 3850 Series Switches

5 Catalyst 3650 Series Switches

When one of the MCs becomes the RRM group leader, the remaining MCs become RRM group members. RRM group members send their RF information to the Group Leader. The group leader determines a channel and Tx power plan for the network and passes the information back to the RF group members. The MCs push the power plan to MA for the radios that belong to MA. These channel and power plans are ultimately pushed down to individual radios.

Note MC has MA functionality within it.

Mobility Agent

The MA communicates with the MC. The MC includes MAC or IP address of the switch/controller while communicating with the MA.

The MA provides the following information when polled by the MC:

- Interference or noise data.

- Neighbor data.

- Radio capabilities (supported channels, power levels).

- Radio configuration (power, channel, channel width).

- Radar data.

The MC exchanges the following information with the switch/controller (MA). The message includes:

- Configurations (channel/power/channel width) for individual radios.

- Polling requests for current configurations and RF measurements for individual radios

- Group Leader Update

In turn, the MA communicates the following messages with the MC:

- RF measurements from radios (e.g. load, noise and neighbor information)

- RF capabilities and configurations of individual radios

The MA sets channel, power, and channel width on the radios when directed by the MC. The DFS, coverage hole detection/mitigation, static channel/power configurations are performed by the MA.

Information About Rogue Access Point Detection in RF Groups

After you have created an RF group of Cisco WLCs, you need to configure the access points connected to the Cisco WLCs to detect rogue access points. The access points will then select the beacon/probe-response frames in neighboring access point messages to see if they contain an authentication information element (IE) that matches that of the RF group. If the select is successful, the frames are authenticated. Otherwise, the authorized access point reports the neighboring access point as a rogue, records its BSSID in a rogue table, and sends the table to the Cisco WLC.

Transmit Power Control

The switch dynamically controls access point transmit power based on real-time wireless LAN conditions.

The Transmit Power Control (TPC) algorithm both increases and decreases an access point's power in response to changes in the RF environment. In most instances, TPC seeks to lower an access point's power to reduce interference, but in the case of a sudden change in the RF coverage—for example, if an access point fails or becomes disabled—TPC can also increase power on surrounding access points. This feature is different from coverage hole detection, which is primarily concerned with clients. TPC provides enough RF power to achieve desired coverage levels while avoiding channel interference between access points.

Overriding the TPC Algorithm with Minimum and Maximum Transmit Power Settings

The TPC algorithm balances RF power in many diverse RF environments. However, it is possible that automatic power control will not be able to resolve some scenarios in which an adequate RF design was not possible to

implement due to architectural restrictions or site restrictions—for example, when all access points must be mounted in a central hallway, placing the access points close together, but requiring coverage out to the edge of the building.

In these scenarios, you can configure maximum and minimum transmit power limits to override TPC recommendations. The maximum and minimum TPC power settings apply to all access points through RF profiles in a RF network.

To set the Maximum Power Level Assignment and Minimum Power Level Assignment, enter the maximum and minimum transmit power used by RRM in the text boxes in the Tx Power Control page. The range for these parameters is -10 to 30 dBm. The minimum value cannot be greater than the maximum value; the maximum value cannot be less than the minimum value.

If you configure a maximum transmit power, RRM does not allow any access point attached to the switch to exceed this transmit power level (whether the power is set by RRM TPC or by coverage hole detection). For example, if you configure a maximum transmit power of 11 dBm, then no access point would transmit above 11 dBm, unless the access point is configured manually.

Dynamic Channel Assignment

Two adjacent access points on the same channel can cause either signal contention or signal collision. In a collision, data is not received by the access point. This functionality can become a problem, for example, when someone reading e-mail in a café affects the performance of the access point in a neighboring business. Even though these are completely separate networks, someone sending traffic to the café on channel 1 can disrupt communication in an enterprise using the same channel. Switches can dynamically allocate access point channel assignments to avoid conflict and to increase capacity and performance. Channels are "reused" to avoid wasting scarce RF resources. In other words, channel 1 is allocated to a different access point far from the café, which is more effective than not using channel 1 altogether.

The switch's Dynamic Channel Assignment (DCA) capabilities are also useful in minimizing adjacent channel interference between access points. For example, two overlapping channels in the 802.11b/g band, such as 1 and 2, cannot both simultaneously use 11/54 Mbps. By effectively reassigning channels, the switch keeps adjacent channels separated.

Note   We recommend that you use only non-overlapping channels (1, 6, 11, and so on).

The switch examines a variety of real-time RF characteristics to efficiently handle channel assignments as follows:

- Access point received energy—The received signal strength measured between each access point and its nearby neighboring access points. Channels are optimized for the highest network capacity.

- Noise—Noise can limit signal quality at the client and access point. An increase in noise reduces the effective cell size and degrades user experience. By optimizing channels to avoid noise sources, the switch can optimize coverage while maintaining system capacity. If a channel is unusable due to excessive noise, that channel can be avoided.

- 802.11 Interference—Interference is any 802.11 traffic that is not part of your wireless LAN, including rogue access points and neighboring wireless networks. Lightweight access points constantly scan all channels looking for sources of interference. If the amount of 802.11 interference exceeds a predefined configurable threshold (the default is 10 percent), the access point sends an alert to the switch. Using the RRM algorithms, the switch may then dynamically rearrange channel assignments to increase system

performance in the presence of the interference. Such an adjustment could result in adjacent lightweight access points being on the same channel, but this setup is preferable to having the access points remain on a channel that is unusable due to an interfering foreign access point.

In addition, if other wireless networks are present, the switch shifts the usage of channels to complement the other networks. For example, if one network is on channel 6, an adjacent wireless LAN is assigned to channel 1 or 11. This arrangement increases the capacity of the network by limiting the sharing of frequencies. If a channel has virtually no capacity remaining, the switch may choose to avoid this channel. In very dense deployments in which all nonoverlapping channels are occupied, the switch does its best, but you must consider RF density when setting expectations.

- Load and utilization—When utilization monitoring is enabled, capacity calculations can consider that some access points are deployed in ways that carry more traffic than other access points (for example, a lobby versus an engineering area). The switch can then assign channels to improve the access point with the worst performance reported. The load is taken into account when changing the channel structure to minimize the impact on clients currently in the wireless LAN. This metric keeps track of every access point's transmitted and received packet counts to determine how busy the access points are. New clients avoid an overloaded access point and associate to a new access point. This parameter is disabled by default.

The switch combines this RF characteristic information with RRM algorithms to make system-wide decisions. Conflicting demands are resolved using soft-decision metrics that guarantee the best choice for minimizing network interference. The end result is optimal channel configuration in a three-dimensional space, where access points on the floor above and below play a major factor in an overall wireless LAN configuration.

Note   Radios using 40-MHz channels in the 2.4-GHz band or or 80MHz channels are not supported by DCA.

The RRM startup mode is invoked in the following conditions:

- In a single-switch environment, the RRM startup mode is invoked after the switch is rebooted.

- In a multiple-switch environment, the RRM startup mode is invoked after an RF Group leader is elected.

You can trigger RRM startup mode from CLI.

RRM startup mode runs for 100 minutes (10 iterations at 10-minute intervals). The duration of the RRM startup mode is independent of the DCA interval, sensitivity, and network size. The startup mode consists of 10 DCA runs with high sensitivity (making channel changes easy and sensitive to the environment) to converge to a steady state channel plan. After the startup mode is finished, DCA continues to run at the specified interval and sensitivity.

Coverage Hole Detection and Correction

The RRM coverage hole detection algorithm can detect areas of radio coverage in a wireless LAN that are below the level needed for robust radio performance. This feature can alert you to the need for an additional (or relocated) lightweight access point.

If clients on a lightweight access point are detected at threshold levels (RSSI, failed client count, percentage of failed packets, and number of failed packets) lower than those specified in the RRM configuration, the access point sends a "coverage hole" alert to the switch. The alert indicates the existence of an area where clients are continually experiencing poor signal coverage, without having a viable access point to which to roam. The switch discriminates between coverage holes that can and cannot be corrected. For coverage holes

that can be corrected, the switch mitigates the coverage hole by increasing the transmit power level for that specific access point. The switch does not mitigate coverage holes caused by clients that are unable to increase their transmit power or are statically set to a power level because increasing their downstream transmit power might increase interference in the network.

How to Configure RRM

Configuring Advanced RRM CCX Parameters (CLI)

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz | 5ghz rrm ccx location-measurement** *interval*
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 2	**ap dot11 24ghz	5ghz rrm ccx location-measurement** *interval* **Example:** Switch(config)# **ap dot11 24ghz rrm ccx location-measurement 15**	Configures the interval for 802.11 CCX client location measurements. The range is from 10 to 32400 seconds.
Step 3	**end** **Example:** Switch(config)# **end**	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Configuring Neighbor Discovery Type (CLI)

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz | 5ghz rrm ndp-type {protected | transparent}**
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 2	**ap dot11 24ghz	5ghz rrm ndp-type {protected	transparent}** **Example:** Switch(config)#**ap dot11 24ghz rrm ndp-type protected** Switch(config)#**ap dot11 24ghz rrm ndp-type transparent**	Configures the neighbor discovery type. By default, the mode is set to "transparent". • **protected**—Sets the neighbor discover type to protected. Packets are encrypted. • **transparent**—Sets the neighbor discover type to transparent. Packets are sent as is.
Step 3	**end** **Example:** Switch(config)# **end**	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Configuring RRM Profile Thresholds, Monitoring Channels, and Monitoring Intervals (GUI)

Step 1   Choose **Configuration** > **Wireless** > **802.11a/n/ac** > **RRM** > **General** or **Configuration** > **Wireless** > **802.11b/g/n** > **RRM** > **General** to open RRM General page.

Step 2   Configure profile thresholds used for alarming as follows:

Note   The profile thresholds have no bearing on the functionality of the RRM algorithms. Switches send an SNMP trap (or an alert) to the Cisco Prime Infrastructure or another trap receiver when individual APs values set for these threshold parameters are exceeded.

a) In the **Interference** text box, enter the percentage of interference (802.11 traffic from sources outside of your wireless network) on a single access point. The valid range is 0 to 100%, and the default value is 10%.

b) In the **Clients** text box, enter the number of clients on a single access point. The valid range is 1 to 75, and the default value is 12.

c) In the **Noise** text box, enter the level of noise (non-802.11 traffic) on a single access point. The valid range is −127 to 0 dBm, and the default value is −70 dBm.

d) In the **Utilization** text box, enter the percentage of RF bandwidth being used by a single access point. The valid range is 0 to 100%, and the default value is 80%.

e) In the **Throughput** text box, enter the level of Throughput being used by a single access point. The valid range is 1000 to 10000000, and the default value is 1000000.

Step 3 From the **Channel List** drop-down list, choose one of the following options to specify the set of channels that the access point uses for RRM scanning:

- **All Channels**—RRM channel scanning occurs on all channels supported by the selected radio, which includes channels not allowed in the country of operation.

- **Country Channels**—RRM channel scanning occurs only on the data channels in the country of operation. This is the default value.

- **DCA Channels**—RRM channel scanning occurs only on the channel set used by the DCA algorithm, which by default includes all of the non-overlapping channels allowed in the country of operation. However, you can specify the channel set to be used by DCA if desired. To do so, follow instructions in the Dynamic Channel Assignment.

Step 4 Configure monitor intervals as follows:

1 In the **Channel Scan Interval** text box, enter (in seconds) the sum of the time between scans for each channel within a radio band. The entire scanning process takes 50 ms per channel, per radio and runs at the interval configured here. The time spent listening on each channel is determined by the non-configurable 50-ms scan time and the number of channels to be scanned. For example, in the U.S. all 11 802.11b/g channels are scanned for 50 ms each within the default 180-second interval. So every 16 seconds, 50 ms is spent listening on each scanned channel (180/11 = ~16 seconds). The Channel Scan Interval parameter determines the interval at which the scanning occurs. The valid range is 60 to 3600 seconds, and the default value for 802.11a/n/ac and 802.11b/g/n radios is 180 seconds.

2 In the **Neighbor Packet Frequency** text box, enter (in seconds) how frequently neighbor packets (messages) are sent, which eventually builds the neighbor list. The valid range is 60 to 3600 seconds, and the default value is 60 seconds.

Note If the access point radio does not receive a neighbor packet from an existing neighbor within 60 minutes, the Cisco WLC deletes that neighbor from the neighbor list.

Step 5 Click **Apply**.

Step 6 Click **Save Configuration**.

Note Click **Set to Factory Default** if you want to return all of the Cisco WLC's RRM parameters to their factory-default values.

Configuring RF Groups

This section describes how to configure RF groups through either the GUI or the CLI.

Note The RF group name is generally set at deployment time through the Startup Wizard. However, you can change it as necessary.

Note When the multiple-country feature is being used, all Cisco WLCs intended to join the same RF group must be configured with the same set of countries, configured in the same order.

Note You can also configure RF groups using the Cisco Prime Infrastructure.

Configuring the RF Group Mode (GUI)

Step 1 Choose **Configuration** > **Wireless** > **802.11a/n/ac** > **RRM** > **RF Grouping** or or **Configuration** > **Wireless** > **802.11b/g/n** > **RRM** > **RF Grouping** to open the RF Grouping page.

Step 2 From the **Group Mode** drop-down list, choose the mode that you want to configure for this Cisco WLC.
You can configure RF grouping in the following modes:

- auto—Sets the RF group selection to automatic update mode.

  Note A configured static leader cannot become a member of another RF group until its mode is set to "auto".

- leader—Sets the RF group selection to static mode, and sets this Cisco WLC as the group leader.

- off—Sets the RF group selection off. Every Cisco WLC optimizes its own access point parameters.

  Note A Cisco WLC with a lower priority cannot assume the role of a group leader if a Cisco WLC with a higher priority is available. Here, priority is related to the processing power of the Cisco WLC.

  Note We recommend that Cisco WLCs participate in automatic RF grouping. You can override RRM settings without disabling automatic RF group participation.

Step 3 Click **Apply** to save the configuration and click **Restart** to restart the RRM RF Grouping algorithm.

Step 4 If you configured RF Grouping mode for this Cisco WLC as a static leader, you can add group members from the Group Members section as follows:

1 In the switch Name text box, enter the Cisco WLC that you want to add as a member to this group.

2 In the IP Address text box, enter the IP address of the Cisco WLC.

3 Click **Add** to add the member to this group.

  Note If the member has not joined the static leader, the reason of the failure is shown in parentheses.

Step 5 Click **Apply**.

Step 6 Click **Save Configuration**.

Configuring RF Group Selection Mode (CLI)

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz | 5ghz rrm group-mode**{**auto** | **leader** | **off**}
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ap dot11 24ghz	5ghz rrm group-mode**{**auto**	**leader**	**off**} **Example:** `Switch(config)#ap dot11 24ghz rrm group-mode leader`	Configures RF group selection mode for 802.11 bands. • **auto**—Sets the 802.11 RF group selection to automatic update mode. • **leader**—Sets the 802.11 RF group selection to leader mode. • **off**—Disables the 802.11 RF group selection.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Configuring an RF Group Name (CLI)

SUMMARY STEPS

1. **configure terminal**
2. **wireless rf-network** *name*
3. **end**
4. **show network profile** *profile_number*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**wireless rf-network** *name* **Example:** `Switch (config)# wireless rf-network test1`	Creates an RF group. The group name should be ASCII String up to 19 characters and is case sensitive. **Note** Repeat this procedure for each controller that you want to include in the RF group.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.
Step 4	**show network profile** *profile_number*	Displays the RF group. **Note** You can view the network profile number from 1 to 4294967295.

Configuring an RF Group Name (GUI)

Step 1   Choose **Configuration** > **Controller** > **General** to open the General page.

Step 2   Enter a name for the RF group in the RF Group Name text box. The name can contain up to 19 ASCII characters and is case sensitive.

Step 3   Click **Apply** to commit your changes.

Step 4   Click **Save Configuration** to save your changes.

Step 5   Repeat this procedure for each controller that you want to include in the RF group.

Configuring Members in a 802.11 Static RF Group (CLI)

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz | 5ghz rrm group-member** *group_name ip_addr*
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 2	**ap dot11 24ghz	5ghz rrm group-member** *group_name ip_addr* **Example:** Switch(config)#**ap dot11 24ghz rrm group-member Grpmem01 10.1.1.1**	Configures members in a 802.11 static RF group. The group mode should be set as leader for the group member to be active.
Step 3	**end** **Example:** Switch(config)# **end**	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Configuring Transmit Power Control

Configuring the Tx-Power Control Threshold (CLI)

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz | 5ghz rrm tpc-threshold** *threshold_value*
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.

	Command or Action	Purpose
Step 2	**ap dot11 24ghz	5ghz rrm tpc-threshold** *threshold_value* **Example:** Switch(config)#**ap dot11 24ghz rrm tpc-threshold -60**	Configures the Tx-power control threshold used by RRM for auto power assignment. The range is from −80 to −50.
Step 3	**end** **Example:** Switch(config)# **end**	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Configuring the Tx-Power Level (CLI)

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz | 5ghz rrm txpower**{*trans_power_level* | **auto** | **max** | **min** | **once**}
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 2	**ap dot11 24ghz	5ghz rrm txpower**{*trans_power_level*	**auto**	**max**	**min**	**once**} **Example:** Switch(config)#**ap dot11 24ghz rrm txpower auto**	Configures the 802.11 tx-power level • **trans_power_level**—Sets the transmit power level. • **auto**—Enables auto-RF. • **max**—Configures the maximum auto-RF tx-power. • **min**—Configures the minimum auto-RF tx-power. • **once**—Enables one-time auto-RF.
Step 3	**end** **Example:** Switch(config)# **end**	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Configuring Transmit Power Control (GUI)

Step 1 Choose **Configuration** > **Wireless** > **802.11a/n/ac** > **RRM** > **TPC** or **Configuration** > **Wireless** > **802.11b/g/n** > **RRM** > **TPC** to open RRM Tx Power Control (TPC) page.

Step 2 Choose the Transmit Power Control.
Coverage Optimal Mode (TPCv1)— Offers strong signal coverage and stability. In this mode, power can be kept low to gain extra capacity and reduce interference.

Step 3 Choose one of the following options from the Power Level Assignment Method list to specify the Cisco WLC's dynamic power assignment mode:

- **Automatic**—Causes the Cisco WLC to periodically evaluate and, if necessary, update the transmit power for all joined access points. This is the default value.

- **On Demand**—Causes the Cisco WLC to periodically evaluate the transmit power for all joined access points. However, the Cisco WLC updates the power, if necessary, only when you click **Apply** after choosing **On Demand**.

  Note The Cisco WLC does not evaluate and update the transmit power immediately when you click **Apply** after choosing **On Demand**. It waits for the next 600-second interval. This value is not configurable.

- **Fixed**—Prevents the Cisco WLC from evaluating and, if necessary, updating the transmit power for joined access points. The power level is set to the fixed value chosen from the drop-down list. The corresponding option for **Fixed** when you try to configure from CLI is **once**.

  Note The transmit power level is assigned an integer value instead of a value in mW or dBm. The integer corresponds to a power level that varies depending on the regulatory domain, channel, and antennas in which the access points are deployed.

  Note For optimal performance, we recommend that you use the Automatic setting.

Step 4 Enter the maximum and minimum power level assignment values in the Maximum Power Level Assignment and Minimum Power Level Assignment text boxes.
The range for the Maximum Power Level Assignment is −10 to 30 dBm.

The range for the Minimum Power Level Assignment is −10 to 30 dBm.

Step 5 In the Power Threshold text box, enter the cutoff signal level used by RRM when determining whether to reduce an access point's power. The default value for this parameter is −70 dBm for TPCv1, but can be changed when access points are transmitting at higher (or lower) than desired power levels.
The range for this parameter is −80 to −50 dBm. Increasing this value (between −65 and −50 dBm) causes the access points to operate at a higher transmit power. Decreasing the value has the opposite effect.

In applications with a dense population of access points, it may be useful to decrease the threshold to −80 or −75 dBm to reduce the number of BSSIDs (access points) and beacons seen by the wireless clients. Some wireless clients might have difficulty processing a large number of BSSIDs or a high beacon rate and might exhibit problematic behavior with the default threshold.

This page also shows the following nonconfigurable transmit power level parameter settings:

- Power Neighbor Count—The minimum number of neighbors an access point must have for the transmit power control algorithm to run.

- Power Assignment Leader—The MAC address of the RF group leader, which is responsible for power level assignment.

- Last Power Level Assignment—The last time RRM evaluated the current transmit power level assignments.

Step 6   Click **Apply**.

Step 7   Click **Save Configuration**.

Configuring 802.11 RRM Parameters

Configuring Advanced 802.11 Channel Assignment Parameters (CLI)

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz | 5ghz rrm channel cleanair-event sensitivity {high | low | medium}**
3. **ap dot11 24ghz | 5ghz rrm channel dca**{*channel number*| **anchor-time | global**{**auto**| **once**}| **interval | min-metric | sensitivity**{**high | low | medium**}}
4. **ap dot11 5ghz rrm channel dca chan-width-11n {20 | 40}**
5. **ap dot11 24ghz | 5ghz rrm channel device**
6. **ap dot11 24ghz | 5ghz rrm channel foreign**
7. **ap dot11 24ghz | 5ghz rrm channel load**
8. **ap dot11 24ghz | 5ghz rrm channel noise**
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** Example: `Switch# configure terminal`	Enters global configuration mode.
Step 2	**ap dot11 24ghz	5ghz rrm channel cleanair-event sensitivity {high	low	medium}**	Configures CleanAir event-driven RRM parameters. • **High**–Specifies the most sensitivity to non-Wi-Fi interference as indicated by the air quality (AQ) value.

	Command or Action	Purpose
	Example: `Switch(config)#ap dot11 24ghz rrm channel cleanair-event sensitivity high`	• **Low**–Specifies the least sensitivity to non-Wi-Fi interference as indicated by the AQ value. • **Medium**–Specifies medium sensitivity to non-Wi-Fi interference as indicated by the AQ value.

Step 3	**ap dot11 24ghz** | **5ghz rrm channel dca**{*channel number*| **anchor-time** | **global**{**auto**| **once**}| **interval** | **min-metric** | **sensitivity**{**high** | **low** | **medium**}}
	
	Example:
	
	`Switch(config)#ap dot11 24ghz rrm channel dca interval 2`
		Configures Dynamic Channel Assignment (DCA) algorithm parameters for the 802.11 band.
		
		• *<1-14>*–Enter a channel number to be added to the DCA list.
		
		• **anchor-time**–Configures the anchor time for the DCA. The range is between 0 and 23 hours.
		
		• **global**–Configures the DCA mode for all 802.11 Cisco APs.
		
		  ◦ **auto**–Enables auto-RF.
		
		  ◦ **once**–Enables auto-RF only once.
		
		• **interval**–Configures the DCA interval value. The values are 1, 2, 3, 4, 6, 8, 12 and 24 hours and the default value 0 denotes 10 minutes.
		
		• **min-metric**–Configures the DCA minimum RSSI energy metric. The range is between -100 and -60.
		
		• **sensitivity**–Configures the DCA sensitivity level to changes in the environment.
		
		  ◦ **high**–Specifies the most sensitivity.
		
		  ◦ **low**–Specifies the least sensitivity.
		
		  ◦ **medium**–Specifies medium sensitivity.

Step 4	**ap dot11 5ghz rrm channel dca chan-width-11n** {**20** | **40**}	Configures the DCA channel width for all 802.11n radios in the 5-GHz band. • 20 sets the channel width for 802.11n radios to 20 MHz. This is the default value. • 40 sets the channel width for 802.11n radios to 40 MHz.
Step 5	**ap dot11 24ghz** | **5ghz rrm channel device** **Example:** `Switch(config)#ap dot11 24ghz rrm channel device`	Configures the persistent non-Wi-Fi device avoidance in the 802.11 channel assignment.

	Command or Action	Purpose
Step 6	**ap dot11 24ghz	5ghz rrm channel foreign** **Example:** `Switch(config)#`**ap dot11 24ghz rrm channel foreign**	Configures the foreign AP 802.11 interference avoidance in the channel assignment.
Step 7	**ap dot11 24ghz	5ghz rrm channel load** **Example:** `Switch(config)#`**ap dot11 24ghz rrm channel load**	Configures the Cisco AP 802.11 load avoidance in the channel assignment.
Step 8	**ap dot11 24ghz	5ghz rrm channel noise** **Example:** `Switch(config)#`**ap dot11 24ghz rrm channel noise**	Configures the 802.11 noise avoidance in the channel assignment.
Step 9	**end** **Example:** `Switch(config)#` **end**	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Configuring Dynamic Channel Assignment (GUI)

You can specify the channels that the Dynamic Channel Assignment (DCA) algorithm considers when selecting the channels to be used for RRM scanning by using the Cisco WLC GUI.

Note   This functionality is helpful when you know that the clients do not support certain channels because they are legacy devices or they have certain regulatory restrictions.

Step 1   Disable the 802.11a/n/ac or 802.11b/g/n network as follows:

a) Choose **Configuration** > **Wireless** > **802.11a/n/ac** > **Network** or **Configuration** > **Wireless** > **802.11b/g/n** > **Network** to open the Global Parameters page.

b) Unselect the **802.11a/n/ac** (or **802.11b/g/n**) **Network Status** check box.

c) Click **Apply**.

Step 2   Choose **Configuration** > **Wireless** > **802.11a/n/ac** > **RRM** > **DCA** or **Configuration** > **Wireless** > **802.11b/g/n** > **RRM** > **DCA** to open the Dynamic Channel Assignment (DCA) page.

Step 3   Choose one of the following options from the **Channel Assignment Method** drop-down list to specify the Cisco WLC's DCA mode:

- **Automatic**—Causes the Cisco WLC to periodically evaluate and, if necessary, update the channel assignment for all joined access points. This is the default value.

- **Freeze**—Causes the Cisco WLC to evaluate and update the channel assignment for all joined access points, if necessary, only when you click **Apply** after selecting the **Freeze** option.

  Note The Cisco WLC does not evaluate and update the channel assignment immediately when you click **Apply** after selecting the **Freeze** option. It waits for the next interval to elapse.

- **OFF**—Turns off DCA and sets all access point radios to the first channel of the band. If you choose this option, you must manually assign channels on all radios.

  Note For optimal performance, we recommend that you use the Automatic setting. See the Disabling Dynamic Channel and Power Assignment (GUI) section for instructions on how to disable the Cisco WLC's dynamic channel and power settings.

Step 4   From the Interval drop-down list, choose one of the following options to specify how often the DCA algorithm is allowed to run: **10 minutes**, **1 hour**, **2 hours**, **3 hours**, **4 hours**, **6 hours**, **8 hours**, **12 hours**, or **24 hours**. The default value is 10 minutes.

Step 5   From the AnchorTime drop-down list, choose a number to specify the time of day when the DCA algorithm is to start. The options are numbers between 0 and 23 (inclusive) representing the hour of the day from 12:00 a.m. to 11:00 p.m.

Step 6   From the **DCA Channel Sensitivity** drop-down list, choose one of the following options to specify how sensitive the DCA algorithm is to environmental changes such as signal, load, noise, and interference when determining whether to change channels:

- **Low**—The DCA algorithm is not particularly sensitive to environmental changes.

- **Medium**—The DCA algorithm is moderately sensitive to environmental changes.

- **High**—The DCA algorithm is highly sensitive to environmental changes.

The default value is Medium. The DCA sensitivity thresholds vary by radio band, as noted in the following table:

Table 1: DCA Sensitivity Thresholds

Option	2.4-GHz DCA Sensitivity Threshold	5-GHz DCA Sensitivity Threshold
High	5 dB	5 dB
Medium	10 dB	15 dB
Low	20 dB	20 dB

Step 7   This page also shows the following nonconfigurable channel parameter settings:

- Channel Assignment Leader—The MAC address of the RF group leader, which is responsible for channel assignment.

Step 8   In the DCA Channel List area, the DCA Channels text box shows the channels that are currently selected. To choose a channel, select its check box in the Select column. To exclude a channel, unselect its check box.
The ranges are as follows:

- 802.11a—36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 132, 136, 140, 149, 153, 157, 161, 165 (depending on countries).

- 802.11b/g—1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 (depending on countries).

The defaults are as follows:

- 802.11a—36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 132, 136, 140, 149, 153, 157, 161

- 802.11b/g—1, 6, 11

Step 9 Click **Apply**.

Step 10 Reenable the 802.11 networks as follows:

1 Choose **Configuration** > **Wireless** > **802.11a/n/ac** > **Network** or **Configuration** > **Wireless** > **802.11b/g/n** > **Network** to open the Global Parameters page.

2 Select the **802.11a/n/ac** (or **802.11b/g/n**) **Network Status** check box.

3 Click **Apply**.

Step 11 Click **Save Configuration**.

Configuring 802.11 Coverage Hole Detection (CLI)

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz | 5ghz rrm coverage data**{**fail-percentage | packet-count | rssi-threshold**}
3. **ap dot11 24ghz | 5ghz rrm coverage exception global** *exception level*
4. **ap dot11 24ghz | 5ghz rrm coverage level global** *cli_min exception level*
5. **ap dot11 24ghz | 5ghz rrm coverage voice**{**fail-percentage | packet-count | rssi-threshold**}
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** Switch# `configure terminal`	Enters global configuration mode.
Step 2	**ap dot11 24ghz	5ghz rrm coverage data**{**fail-percentage	packet-count	rssi-threshold**}	Configures the 802.11 coverage hole detection for data packets. • **fail-percentage**—Configures the 802.11 coverage failure-rate threshold for uplink data packets as a percentage that ranges from 1 to 100%.

	Command or Action	Purpose
	Example: Switch**(config)#ap dot11 24ghz rrm coverage data fail-percentage 60**	• **packet-count**—Configures the 802.11 coverage minimum failure count threshold for uplink data packets that ranges from 1 to 255. • **rssi-threshold**—Configures the 802.11 minimum receive coverage level for data packets that range from −90 to −60 dBm.
Step 3	**ap dot11 24ghz | 5ghz rrm coverage exception global** *exception level* **Example:** Switch**(config)#ap dot11 24ghz rrm coverage exception global 50**	Configures the 802.11 Cisco AP coverage exception level as a percentage that ranges from 0 to 100%.
Step 4	**ap dot11 24ghz | 5ghz rrm coverage level global** *cli_min exception level* **Example:** Switch**(config)#ap dot11 24ghz rrm coverage level global 10**	Configures the 802.11 Cisco AP client minimum exception level that ranges from 1 to 75 clients.
Step 5	**ap dot11 24ghz | 5ghz rrm coverage voice**{**fail-percentage | packet-count | rssi-threshold**} **Example:** Switch**(config)#ap dot11 24ghz rrm coverage voice packet-count 10**	Configures the 802.11 coverage hole detection for voice packets. • **fail-percentage**—Configures the 802.11 coverage failure-rate threshold for uplink voice packets as a percentage that ranges from 1 to 100%. • **packet-count**—Configures the 802.11 coverage minimum failure count threshold for uplink voice packets that ranges from 1 to 255. • **rssi-threshold**—Configures the 802.11 minimum receive coverage level for voice packets that range from −90 to −60 dBm.
Step 6	**end** **Example:** Switch(config)# **end**	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Configuring Coverage Hole Detection (GUI)

Step 1 Disable the 802.11 network as follows:

a) Choose **Configuration** > **Wireless** > **802.11a/n/ac** or **Configuration** > **Wireless** > **802.11b/g/n** to open the 802.11a/n/ac (or 802.11b/g/n) Global Parameters page.

b) Unselect the **802.11a/n/ac** (or **802.11b/g/n**) **Network Status** check box.

c) Click **Apply**.

Step 2   Choose **Configuration** > **Wireless** > **802.11a/n/ac** > **RRM** > **Coverage Thresholds** or **Configuration** > **Wireless** > **802.11b/g/n** > **RRM** > **Coverage Thresholds** to open coverage page.

Step 3   Select the **Enable Coverage Hole Detection** check box to enable coverage hole detection, or unselect it to disable this feature. If you enable coverage hole detection, the Cisco WLC automatically determines, based on data received from the access points, if any access points have clients that are potentially located in areas with poor coverage. The default value is selected.

Step 4   In the **Data RSSI** text box, enter the minimum Receive Signal Strength Indication (RSSI) value for data packets received by the access point. The value that you enter is used to identify coverage holes (or areas of poor coverage) within your network. If the access point receives a packet in the data queue with an RSSI value below the value that you enter here, a potential coverage hole has been detected. The valid range is −90 to −60 dBm, and the default value is −80 dBm. The access point takes data RSSI measurements every 5 seconds and reports them to the Cisco WLC in 90-second intervals.

Step 5   In the **Voice RSSI** text box, enter the minimum Receive Signal Strength Indication (RSSI) value for voice packets received by the access point. The value that you enter is used to identify coverage holes within your network. If the access point receives a packet in the voice queue with an RSSI value below the value that you enter here, a potential coverage hole has been detected. The valid range is −90 to −60 dBm, and the default value is −80 dBm. The access point takes voice RSSI measurements every 5 seconds and reports them to the Cisco WLC in 90-second intervals.

Step 6   In the **Min Failed Client Count per AP** text box, enter the minimum number of clients on an access point with an RSSI value at or below the data or voice RSSI threshold. The valid range is 1 to 75, and the default value is 3.

Step 7   In the **Coverage Exception Level per AP** text box, enter the percentage of clients on an access point that are experiencing a low signal level but cannot roam to another access point. The valid range is 0 to 100%, and the default value is 25%.

   Note   If both the number and percentage of failed packets exceed the values configured for Failed Packet Count and Failed Packet Percentage (configurable through the Cisco WLC CLI) for a 5-second period, the client is considered to be in a pre-alarm condition. The Cisco WLC uses this information to distinguish between real and false coverage holes. False positives are generally due to the poor roaming logic implemented on most clients. A coverage hole is detected if both the number and percentage of failed clients meet or exceed the values entered in the Min Failed Client Count per AP and Coverage Exception Level per AP text boxes over two 90-second periods (a total of 180 seconds). The Cisco WLC determines if the coverage hole can be corrected and, if appropriate, mitigates the coverage hole by increasing the transmit power level for that specific access point.

Step 8   Click **Apply**.

Step 9   Reenable the 802.11 network as follows:

a) Choose **Configuration** > **Wireless** > **802.11a/n/ac** > **Network** or **Configuration** > **Wireless** > **802.11b/g/n** > **Network** to open the 802.11a (or 802.11b/g) Global Parameters page.

b) Select the **802.11a/n/ac** (or **802.11b/g/n**) **Network Status** check box.

c) Click **Apply**.

Step 10   Click **Save Configuration**.

Configuring 802.11 Event Logging (CLI)

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz | 5ghz rrm logging {channel | coverage | foreign | load | noise | performance | txpower}**
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.

Step 2	**ap dot11 24ghz	5ghz rrm logging {channel	coverage	foreign	load	noise	performance	txpower}**
								
								Example:
								`Switch(config)#ap dot11 24ghz rrm logging channel`
								
								`Switch(config)#ap dot11 24ghz rrm logging coverage`
								
								`Switch(config)#ap dot11 24ghz rrm logging foreign`
								
								`Switch(config)#ap dot11 24ghz rrm logging load`
								
								`Switch(config)#ap dot11 24ghz rrm logging noise`
								
								`Switch(config)#ap dot11 24ghz rrm logging performance`
								
								`Switch(config)#ap dot11 24ghz rrm logging txpower`
									Configures event-logging for various parameters.
									
									• **channel**—Configures the 802.11 channel change logging mode.
									
									• **coverage**—Configures the 802.11 coverage profile logging mode.
									
									• **foreign**—Configures the 802.11 foreign interference profile logging mode.
									
									• **load**—Configures the 802.11 load profile logging mode.
									
									• **noise**—Configures the 802.11 noise profile logging mode.
									
									• **performance**—Configures the 802.11 performance profile logging mode.
									
									• **txpower**—Configures the 802.11 transmit power change logging mode.

Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Configuring 802.11 Statistics Monitoring (CLI)

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz | 5ghz rrm monitor channel-list**{**all | country | dca**}
3. **ap dot11 24ghz | 5ghz rrm monitor coverage** *interval*
4. **ap dot11 24ghz | 5ghz rrm monitor load** *interval*
5. **ap dot11 24ghz | 5ghz rrm monitor noise** *interval*
6. **ap dot11 24ghz | 5ghz rrm monitor signal** *interval*
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 2	**ap dot11 24ghz	5ghz rrm monitor channel-list**{**all	country	dca**} **Example:** Switch(config)#**ap dot11 24ghz rrm monitor channel-list all**	Sets the 802.11 monitoring channel-list for parameters such as noise/interference/rogue. • **all—** Monitors all channels. • **country—** Monitor channels used in configured country code. • **dca—** Monitor channels used by dynamic channel assignment.
Step 3	**ap dot11 24ghz	5ghz rrm monitor coverage** *interval* **Example:** Switch(config)#**ap dot11 24ghz rrm monitor coverage 600**	Configures the 802.11 coverage measurement interval in seconds that ranges from 60 to 3600.
Step 4	**ap dot11 24ghz	5ghz rrm monitor load** *interval* **Example:** Switch(config)#**ap dot11 24ghz rrm monitor load 180**	Configures the 802.11 load measurement interval in seconds that ranges from 60 to 3600.
Step 5	**ap dot11 24ghz	5ghz rrm monitor noise** *interval* **Example:** Switch(config)#**ap dot11 24ghz rrm monitor noise 360**	Configures the 802.11 noise measurement interval (channel scan interval) in seconds that ranges from 60 to 3600.

	Command or Action	Purpose
Step 6	**ap dot11 24ghz | 5ghz rrm monitor signal** *interval* **Example:** Switch(config)#**ap dot11 24ghz rrm monitor signal 480**	Configures the 802.11 signal measurement interval (neighbor packet frequency) in seconds that ranges from 60 to 3600.
Step 7	**end** **Example:** Switch(config)# **end**	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Configuring the 802.11 Performance Profile (CLI)

SUMMARY STEPS

1. **configure terminal**
2. **ap dot11 24ghz \| 5ghz rrm profile clients** *cli_threshold_value*
3. **ap dot11 24ghz \| 5ghz rrm profile foreign** *int_threshold_value*
4. **ap dot11 24ghz \| 5ghz rrm profile noise** *for_noise_threshold_value*
5. **ap dot11 24ghz \| 5ghz rrm profile throughput** *throughput_threshold_value*
6. **ap dot11 24ghz \| 5ghz rrm profile utilization** *rf_util_threshold_value*
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 2	**ap dot11 24ghz | 5ghz rrm profile clients** *cli_threshold_value* **Example:** Switch(config)#**ap dot11 24ghz rrm profile clients 20**	Sets the threshold value for 802.11 Cisco AP clients that range between 1 and 75 clients.

	Command or Action	**Purpose**
Step 3	**ap dot11 24ghz	5ghz rrm profile foreign** *int_threshold_value* **Example:** `Switch(config)#`**`ap dot11 24ghz rrm profile foreign 50`**	Sets the threshold value for 802.11 foreign interference that ranges between 0 and 100%.
Step 4	**ap dot11 24ghz	5ghz rrm profile noise** *for_noise_threshold_value* **Example:** `Switch(config)#`**`ap dot11 24ghz rrm profile noise -65`**	Sets the threshold value for 802.11 foreign noise ranges between −127 and 0 dBm.
Step 5	**ap dot11 24ghz	5ghz rrm profile throughput** *throughput_threshold_value* **Example:** `Switch(config)#`**`ap dot11 24ghz rrm profile throughput 10000`**	Sets the threshold value for 802.11 Cisco AP throughput that ranges between 1000 and 10000000 bytes per second.
Step 6	**ap dot11 24ghz	5ghz rrm profile utilization** *rf_util_threshold_value* **Example:** `Switch(config)#`**`ap dot11 24ghz rrm profile utilization 75`**	Sets the threshold value for 802.11 RF utilization that ranges between 0 to 100%.
Step 7	**end** **Example:** `Switch(config)#` **`end`**	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Configuring Rogue Access Point Detection in RF Groups

Configuring Rogue Access Point Detection in RF Groups (CLI)

Before You Begin

Ensure that each Cisco WLC in the RF group has been configured with the same RF group name.

Note The name is used to verify the authentication IE in all beacon frames. If the Cisco WLCs have different names, false alarms will occur.

SUMMARY STEPS

1. **ap name** *Cisco_AP* **mode {local | monitor}**
2. **end**
3. **configure terminal**
4. **wireless wps ap-authentication**
5. **wireless wps ap-authentication threshold** *value*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**ap name** *Cisco_AP* **mode {local	monitor}** **Example:** `Switch# ap name ap1 mode local`	Configures a particular access point for local (normal) mode or monitor (listen-only) mode. Perform this step for every access point connected to the Cisco WLC.
Step 2	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.
Step 3	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 4	**wireless wps ap-authentication** **Example:** `Switch (config)# wireless wps ap-authentication`	Enables rogue access point detection.
Step 5	**wireless wps ap-authentication threshold** *value* **Example:** `Switch (config)# wireless wps ap-authentication threshold 50`	Specifies when a rogue access point alarm is generated. An alarm occurs when the threshold value (which specifies the number of access point frames with an invalid authentication IE) is met or exceeded within the detection period. The valid threshold range is from 1 to 255, and the default threshold value is 1. To avoid false alarms, you may want to set the threshold to a higher value. **Note** Enable rogue access point detection and threshold value on every Cisco WLC in the RF group. **Note** If rogue access point detection is not enabled on every Cisco WLC in the RF group, the access points on the Cisco WLCs with this feature disabled are reported as rogues.

Enabling Rogue Access Point Detection in RF Groups (GUI)

Step 1   Make sure that each Cisco WLC in the RF group has been configured with the same RF group name.

        Note   The name is used to verify the authentication IE in all beacon frames. If the Cisco WLCs have different names, false alarms will occur.

Step 2   Choose **Configuration** > **Wireless** > **Access Points** > **All APs** to open the All APs page.

Step 3   Click the name of an access point to open the All APs > Edit page.

Step 4   Choose either **local** or **monitor** from the AP Mode drop-down list and click **Apply** to commit your changes.

Step 5   Click **Save Configuration** to save your changes.

Step 6   Repeat Step 2 through Step 5 for every access point connected to the Cisco WLC.

Step 7   Choose **Configuration** > **Security** > **Wireless Protection Policies** > **AP Authentication/MFP** to open the AP Authentication Policy page.

        The name of the RF group to which this Cisco WLC belongs appears at the top of the page.

Step 8   Choose **AP Authentication** from the Protection Type drop-down list to enable rogue access point detection.

Step 9   Enter a number in the Alarm Trigger Threshold edit box to specify when a rogue access point alarm is generated. An alarm occurs when the threshold value (which specifies the number of access point frames with an invalid authentication IE) is met or exceeded within the detection period.

        Note   The valid threshold range is from1 to 255, and the default threshold value is 1. To avoid false alarms, you may want to set the threshold to a higher value.

Step 10   Click **Apply** to commit your changes.

Step 11   Click **Save Configuration** to save your changes.

Step 12   Repeat this procedure on every Cisco WLC in the RF group.

        Note   If rogue access point detection is not enabled on every Cisco WLC in the RF group, the access points on the Cisco WLCs with this feature disabled are reported as rogues.

Monitoring RRM Parameters and RF Group Status

Monitoring RRM Parameters

Table 2: Commands for monitoring Radio Resource Management

Commands	Description
show ap dot11 24ghz ccx	Displays the 802.11b CCX information for all Cisco APs.
show ap dot11 24ghz channel	Displays the configuration and statistics of the 802.11b channel assignment.

Commands	Description
show ap dot11 24ghz coverage	Displays the configuration and statistics of the 802.11b coverage.
show ap dot11 24ghz group	Displays the configuration and statistics of the 802.11b grouping.
show ap dot11 24ghz l2roam	Displays 802.11b l2roam information.
show ap dot11 24ghz logging	Displays the configuration and statistics of the 802.11b event logging.
show ap dot11 24ghz monitor	Displays the configuration and statistics of the 802.11b monitoring.
show ap dot11 24ghz profile	Displays 802.11b profiling information for all Cisco APs.
show ap dot11 24ghz receiver	Displays the configuration and statistics of the 802.11b receiver.
show ap dot11 24ghz summary	Displays the configuration and statistics of the 802.11b Cisco APs.
show ap dot11 24ghz txpower	Displays the configuration and statistics of the 802.11b transmit power control.
show ap dot11 5ghz ccx	Displays 802.11a CCX information for all Cisco APs.
show ap dot11 5ghz channel	Displays the configuration and statistics of the 802.11a channel assignment.
show ap dot11 5ghz coverage	Displays the configuration and statistics of the 802.11a coverage.
show ap dot11 5ghz group	Displays the configuration and statistics of the 802.11a grouping.
show ap dot11 5ghz l2roam	Displays 802.11a l2roam information.
show ap dot11 5ghz logging	Displays the configuration and statistics of the 802.11a event logging.
show ap dot11 5ghz monitor	Displays the configuration and statistics of the 802.11a monitoring.
show ap dot11 5ghz profile	Displays 802.11a profiling information for all Cisco APs.

Commands	Description
show ap dot11 5ghz receiver	Displays the configuration and statistics of the 802.11a receiver.
show ap dot11 5ghz summary	Displays the configuration and statistics of the 802.11a Cisco APs.
show ap dot11 5ghz txpower	Displays the configuration and statistics of the 802.11a transmit power control.

Monitoring RF Group Status (CLI)

This section describes the new commands for RF group status.

The following commands can be used to monitor RF group status on the switch.

Table 3: Monitoring Aggressive Load Balancing Command

Command	Purpose
show ap dot11 5ghz group	Displays the Cisco WLC name which is the RF group leader for the 802.11a RF network.
show ap dot11 24ghz group	Displays the Cisco WLC name which is the RF group leader for the 802.11b/g RF network.

Monitoring RF Group Status (GUI)

Step 1 Choose **Configuration** > **Wireless** > **802.11a/n/ac** > **or 802.11b/g/n > RRM** > **RF Grouping** to open the RF Grouping Algorithm page.
This page shows the details of the RF group, displaying the configurable parameter **Group mode**, the **Group role** of this Cisco WLC, the **Group Update Interval** and the Cisco WLC name and IP address of the **Group Leader** to this Cisco WLC.

Note RF grouping mode can be set using the **Group Mode** drop-down list.

Tip Once a Cisco WLC has joined as a static member and you want to change the grouping mode, we recommend that you remove the member from the configured static-leader and also make sure that a member Cisco WLC has not been configured to be a member on multiple static leaders. This is to avoid repeated join attempts from one or more RF static leaders.

Step 2 (Optional) Repeat this procedure for the network type that you did not select (802.11a/n/ac or 802.11b/g/n).

Examples: RF Group Configuration

This example shows how to configure RF group name:

```
Switch# configure terminal
Switch(config)# wireless rf-network test1
Switch(config)# ap dot11 24ghz shutdown
Switch(config)# end
Switch # show network profile 5
```

This example shows how to configure rogue access point detection in RF groups:

```
Switch# ap name ap1 mode local
Switch# end
Switch# configure terminal
Switch(config)# wireless wps ap-authentication
Switch(config)# wireless wps ap-authentication threshold 50
Switch(config)# end
```

Additional References for Radio Resource Management

Related Documents

Related Topic	Document Title
RRM commands and their details	*RRM Command Reference, Cisco IOS XE Release 3SE (Catalyst 3850 Switches)*

MIBs

MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information For Performing Radio Resource Management Configuration

Release	Feature Information
Cisco IOS XE 3.3SE	This feature was introduced.